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STATE PROTECTION FOR OCEAN TRAVELLERS.

BY REAR-ADMIRAL GEO. W. MELVILLE, ENGINEER-IN-CHIEF OF THE UNITED STATES NAVY.

SINCE the advent of the present year, two events have occurred which have made it clear that those who go down to sea in ships are still exposed to danger. The disappearance of the British gunboat "Condor" and the disablement of the Cunard steamship "Etruria," prove that, despite the skill of commander and crew, accidents are likely to happen to ocean-going vessels which will imperil the safety of ships and passengers. Both these ships had single screws, and an irreparable injury to the propelling engines of either would put her at the mercy of an angry sea.

Very few steamships now carry sail. The competition between ocean-going steamers for passengers and cargo is so keen, that it would not be commercially profitable for steamships to carry the top-hamper and extra men that would be necessary for the management and handling of sail. The warship have to dispensed with masts and spars, because the fighting vessel is now regarded as a simple gun-platform, and any attempt to use sail would interfere with the working of the guns and the securing of a rapid ammunition supply.

In the days of sail a ship was rarely disabled to an extent that would prevent her from eventually reaching port. It was seldom that there happened a worse casualty than the ripping out of a mast, and severe as was the damage that might be caused by such an accident, the ship could still possess sufficient sail area to steer handily.

When steam was first used on ships as motive power, it was only intended that the machinery should be used when going in and out of port, when crossing calm belts, or when great dispatch was necessary. The possession of both sail and steam involved a cross security which made it rare for a vessel to be lost at sea. In the early days of steam navigation, the machinery was made very heavy. The designer gave a large factor of safety to every working part, so that there was little liability of permanent breakdown. It was said that, with the exception of the cylinders, nearly every portion of the early marine engines could have been built by a blacksmith or boiler-maker; but substantial structures were required when blacksmiths and boiler-makers were sometimes assigned to their care and management.

It was not long before it was discovered that the use of sail on board a steamer was incompatible with the earning of fair dividends. Gradually, therefore, the sail area was lessened and the steam installation increased; but while this development gave more money to the owner of the vessel, it afforded less security to the passengers and the crew.

The passing away of the ships of oak with their clouds of snowy canvas, to make way for vessels of steel with their throbbing engines, gave a wonderful impetus to the shipping industry. Remote islands and hermit nations were brought into closer touch with the manufacturing and maritime countries of the world. As time became an important factor in the delivery of ocean cargoes, there came urgent demand for faster ships. Not only was there a desire for a marked increase in speed, but there was also a call for greater steaming radius upon the part of the vessel. The competition between different corporations for the carrying trade of the world made it compulsory that ships making long voyages should frequently put into port to replenish coal bunkers. It was inevitable, therefore, that marine machinery should be made to work more economically, and that it should be built much lighter. With this progression, there was a corresponding advance in the skill, intelligence, and character of the engineer's force.

Competent as the complement in the engine and fire-rooms might become, and skilled as the supervision might grow, the fact was ever kept before the mind of the engine-designer that every ton of machinery was dead weight, and that every pound saved in this respect permitted the carrying of another pound of cargo.

The weight of machinery allowed in proportion to the horsepower developed has been rapidly decreasing, and this accounts for the great number of accidents that are happening at sea. Although there has been steady improvement in the strength and uniformity of the material that enters into the construction of marine machinery, every advance in this direction only encourages the engine-designer to reduce the factor of safety and thus lighten the weight of the machinery parts. The degree to which machinery weights have been decreased could not be more impressively illustrated than by stating that the horse-power developed in a modern torpedo boat of 150 tons trial displacement exceeds the horse-power that was required for a 3,000-ton Cunarder thirty years ago. The piston speed of engines has been doubled and, in some cases, nearly trebled; and it need not be surprising if the breaking of a shaft or the cracking of an engine-frame occasionally happens.

On board the tramp or cargo-carrying steamer the reduction in machinery weight has not been carried to such an extreme, and the reliability of this type of machinery is much greater than that of the passenger ship. These boats seldom carry passengers, and as they need not run on schedule time their engines are seldom forced.

The point has now been reached when the State should give better protection to ocean-going passengers, and the most effective way of securing this reform is to prohibit any single-screw steamer from being regarded as a subsidy mail-boat. It is rather surprising that ocean-going passengers will consent at this late day to travel on board a steamer that is fitted with a single screw. It is more surprising still that there is afloat a private yacht installed with a single-screw propelling engine. It would seem that people who are able to expend $100,000, and in some cases several hundred thousand dollars, on a yacht that is in commission only a few months each year, would see the imperative necessity of increasing her means of safety by fitting a duplicate pair of engines for propelling purposes.

Public sentiment should now be as well educated upon the necessity of a sea-going steamer's possessing twin-screw engines as upon the necessity of a modern railroad's having a double track. There is hardly a village in this country that will now give a franchise to an electric road for the use of the streets without imposing the condition that there shall be sidings sufficient to prevent collisions and accidents. This shows how jealously guarded is the safety of passengers on land.

Like care should be exercised by the State in providing for the safety of those who travel by sea. The loss of comparatively few lives in the Park Avenue tunnel in the City of New York, caused State and municipal authorities to carry on separate and extended investigations as to the character and completeness of the appliances used in that tunnel for the protection of life. As a result of that single accident, it is exceedingly probable that the company owning the tunnel will eventually be compelled to spend millions of dollars in providing greater security for their patrons. The loss of an ocean liner, from unnecessary weakness in construction, may bring the matter of protection at sea very vividly to the public mind, but it is to be hoped that remedial measures will be provided by law before a catastrophe compels the enactment of such legislation.

The ocean passenger companies owe it to the public to give to their patrons all possible protection. The State does much for commerce. A subsidy is given to many ocean steamers. The coast trade is reserved for the vessels flying our flag. The ships and men both of the Navy and the Revenue Marine are at immediate call to aid and protect the merchant vessels. At the public expense, ocean surveys are made, harbors dredged and obstructions to navigation cleared. It is within the direct province and duty of the State, therefore, to regulate the manner in which passenger vessels shall be operated. If it is the prerogative of the State to protect ocean-going passengers from buccaneers and pirates, it is likewise the duty of the commonwealth to prohibit its citizens being carried in vessels which are not up to date in design, and which are not fitted with life-saving devices.

The Congress had no hesitation in compelling railroad corporations to install air-brakes and standard couplers. The same impelling reasons should force steamship companies to build passenger vessels which will have an inner and outer hull, and which will have at least two sets of propelling engines.

The building of twin-screw engines was the sequence of reducing sail on ocean-going steamers. As the sailing vessels carried spare sails and spars, it was necessary to devise some expedient for making the steamer as safe as the old-time clipper.

The advantages resulting from having practically two installations of motive power were very great. Increased security was given to passengers and crew. The commander was enabled to handle his vessel in a manner that could not be done previously. Economy in the consumption of coal was obtained. Structural benefits were also secured, for the engine parts could not only be made interchangeable but lighter, and repairs could be effected much more quickly. There were two disadvantages of such installation—increased first cost, and additional expense in management and maintenance; and it is to save less than fifteen per cent. in the first cost of machinery, and two per cent. in the cost of management and maintenance, that thousands of single-screw steamers are kept plying on the ocean highway.

The cost of installing twin-screw engines need not be much greater than the cost of a single screw of the same power. With twin screws the parts are smaller, and they can be handled, assembled, and fitted more economically. The cost of modern marine-engine forgings increases in rapid progression with size, and the saving that would be effected in this direction would be very large. Several years ago the Union Iron Works, of San Francisco, volunteered to install in a gunboat of the navy, without extra cost, a set of twin-screw engines instead of the single screw that had been arranged for the ship. Other instances could be given where reliable ship-building firms, under special conditions, have offered to install twin screws at a slight cost above that demanded for single screws.

With the installation of twin-screw engines the insurance of ship and cargo would cost less. Additional earnings would also be secured; for, if ocean-travelling were made safer, people would be willing to make a sea-trip who could not now be persuaded to embark on an ocean liner. The increase in revenue from carrying additional passengers would soon make up for any increased first cost of installation of motive power, as well as for the higher cost of maintenance. Self-interest should cause steamship owners to build twin-screw vessels, even if the demands of humanity should not prompt such form of maritime construction. When a corporation should act and will not act, then is the time for the State to intervene.

It is surprising that the single-screw steamer is still a paying investment. Hundreds of thousands of persons travel every year on the ocean, and it would seem as if every one of these passengers should be an active personal force in discouraging travel by such conveyance. Several years ago, a distinguished ex-Secretary of the Navy told me that on one of his trips, just after starting from New York for Liverpool, he found that he was on board a single-screw vessel. As executive head of the Navy Department, the subject of twin screws had been officially acted upon by him, and he had become convinced that no warship of any size should be fitted with a single propeller. Holding such positive views on this question, and finding himself on board a single-screw steamer, while all his friends had taken passage in ships fitted with twin screws, he was, naturally, exceedingly uncomfortable. The thought suggested itself that through carelessness he was travelling in a dangerous ship, and that it was like voluntarily journeying on a railroad whose equipment contained no safety devices and whose rolling stock was out of date. The feeling of insecurity so preyed upon his mind, that upon reaching port he not only found himself in an exceedingly nervous state, but it was evident also that he had secured no benefit from the sea trip. He could not rid himself of his depression until he had cancelled his return passage in the single-screw ship, and secured for the homeward voyage a state-room on a twin-screw steamer.

Hundreds of instances could be cited where single-screw ships have had the misfortune to break their shafts, lose their propellers or suffer other casualties which have rendered them helpless, but which would have only delayed the twin-screw steamer. The experience of the "Umbria," a sister ship to the "Etruria," may be recalled. This vessel left Liverpool for New York in December, 1892, with 380 passengers on board. She encountered continuous bad weather for nearly a week, and when near the Newfoundland coast her propeller shaft broke. She was picked up by a passing steamer, which attempted to tow her. The sea was too heavy for this undertaking, however, and the attempt had to be abandoned. From the time of the accident to the vessel, her Chief Engineer realized that the "Umbria" could only be saved by making a temporary repair which would enable the ship to be moved by her own propelling engines. Through skill, almost bordering on genius, and by executive leadership of rare ability, the propeller shaft was repaired so efficiently that the vessel was able to resume her voyage, and, to the delight of millions of people in England and America, the ship reached New York under her own steam. The work of Chief-Engineer Tomlinson, of the "Umbria," was deserving of royal recognition.

All sailors can tell tragic and yet inspiring tales of the sinking of single-screw steamers, whose loss might have been averted if the ship had been fitted with twin-screw engines. About seven years ago, the German gunboat "Iltis" was lost in a typhoon off the China coast. The ship was bravely weathering the hurricane until she lost her propeller. Although crew and officers realized that the end was near, there was no fear in their hearts. Huddling together on deck, they raised aloft the flag of Germany to the topmast, and then they tried to drown the mad requiem of the tempest by cheering for Kaiser, for Home and for Country. Even as the wild waves were overpowering the brave sailors of the Fatherland, the last remnant of the heroic band were seen clasping hands, and were heard singing, even in the jaws of death, that greatest of battle hymns—Luther's "*Ein Feste Burg.*" It may be that every nation requires some men to glory their apostleship in such manner, so that future generations in recalling their deeds may be incited to make like sacrifices for the honor and advancement of the flag. But after such sacrifice has been made by some, it is the duty of the State to take good care that all others who go down to the sea in ships shall go on board vessels whose design and construction are in accordance with existing needs.

There should also be a stringent national statute compelling ship owners to provide an adequate and efficient complement of men and officers, both on deck and in the engine rooms of every sea-going passenger ship, for safely operating the vessel. No officer or member of the crew should be permitted to stand watch over eight hours a day on board any sea-going vessel. In addition to his regular watch duty, practically every man on board ship will be called upon for extra duty, for, when getting under way, coming to anchor, in times of rough weather, and when casualties occur, all hands are called to their posts.

There would be less going to sea upon the part of commercial travellers, tourists, and the general public if they only knew of the physical condition of officers and men upon particular occasions. When men are under physical and mental strain for a protracted period it should not excite surprise that at times it requires the exercise of high moral courage and strong will power to continue on duty. Only a few years ago, from sheer exhaustion, one of the pilots of a ferry-boat plying between Brooklyn and

New York fell asleep at his post, after having been continuously at the wheel for over eighteen hours. As a result, there was a collision with another ferry-boat and hundreds of lives were placed in peril. This sleeping on post upon the part of sea-going men, due to overwork, is a much more common occurrence than is realized.

Not only should every sea-going steamer be installed with at least two screws, but the vessel should be required to possess an inner and an outer hull, so that, if either structure should be ruptured, the vessel could still proceed on her way. The appalling loss of life caused by the sinking of the "City of Rio de Janeiro" could have been prevented if that vessel had been built on the cellular system. She had crossed the Pacific, she had heard the fog-horns of the Golden Gate, and while groping in the mist for the entrance to the harbor of San Francisco, she struck a rock and sank within a few minutes. The financial loss alone resulting from the sinking of that ship was sufficient to have fitted double bottoms to every vessel of the line to which she belonged.

It is not only the outer hull which is likely to be ruptured, from striking a reef or from collision, but even the inner hull may be seriously rent from various causes. The fact will not be forgotten that, when the collapse of one of the twin-screw engines of the "City of Paris" took place, some of the reciprocating parts of the disabled engine tore a hole in both the outer and inner bottoms. The ship reached port by reason of the fact that her cellular system of construction prevented the other engine compartment from being filled with water. The "Oregon"—the "Constitution" of the present generation—would now be a wreck near Shantung promontory on the China coast, if it were not for the fact that she had an inner as well as an outer hull. The saving of that historic ship to the service by reason of the fact that she had double bottoms, will pay for all the inner hulls that the American Navy will require for the next ten years.

The maritime laws of all countries should prohibit any steamers which did not carry an adequate complement of trained men, which did not possess an installation of twin-screws, and which was not constructed with double bottoms from regularly carrying passengers. These three requisites are necessary for efficiency as well as security—the inner hull is a complement of the second propelling engine, and the providing of an adequate complement is but simply the enactment of a just law preventing employers from overworking their help.

Those who have reason for crossing the Atlantic in five days are willing to pay for increased security, and it would be a good investment for future "greyhounds" to be fitted with three sets of propelling machinery. Thousands of persons in this country do not consider it an extravagance to travel in a special car. Tens of thousands of people use the Pullman day-coaches even for short journeys. Such a class of patrons should insist that all passenger steamers, whose motive power was over 20,000 horse-power, should have triple screws installed. Ship-owners may object to the additional first cost of such installation, as some now object to the extra cost for the installation of twin screws. But the class of tourists who travel in such boats would cheerfully recognize the fact that increased protection was worth paying for. Such an installation of motive power would also increase the chances of the vessels running upon schedule time.

The average ocean tourist is of the belief that there is very little danger attending a journey on an ocean greyhound. The cost of a suite of desirable state-rooms is increasing very rapidly, and increased protection should go with this higher tariff. But with the rivalry existing between the steamers of different nations, there comes a demand for increased installation of motive power. There is one problem to be solved in designing these twin-screw ships which is of great importance to the engineer, but which is of greater consequence to the patrons of the principal "liners." If twin-screw engines are to be insisted upon for the largest of the Atlantic steamers, then accidents to the shaft may be anticipated. It has even been suggested that a shaft should be designed strong enough to convey twenty thousand horse-power to the propellers. The draught of the ship must necessarily limit the size of the propellers, and therefore to transmit such power as that of 20,000 horses, an excessive pitch must be given to the blades. If the pitch of the propeller is increased, the flattening of the surface of the blades is likely to follow, and the final resultant is a broken shaft or impaired propeller blades. Security in respect to propeller shafts of very high-powered steamers can only be obtained by triple-screw engines, in which the power is distributed so as not to subject any one shaft to excessive strain.

It may be incidentally stated that the triple screw is no novelty in naval construction. It is in use in foreign navies, as well as in our own; for Russia, France, Germany, and the United States have war vessels fitted in such manner. France has ten battleships and nineteen cruisers of this type. In the case of Germany, the decision has been practically reached, after competitive trial of the twin and triple-screw systems, to adopt the triple-screw design exclusively in all future warships of the home fleet.

As the primary purpose of the writer is to demand the installation of twin screws and double bottoms on board every seagoing passenger steamer, it will only be possible to refer briefly to the essential reasons for installing triple-screw machinery in ships of very large power.

First, there would be economic advantages, since it would only be necessary to use the amount of power required for conditions existing. There would be times when it would only be necessary to move the ship very slowly, and then the single screw could efficiently do the work.

In addition to the economic advantages, there are structural reasons why the system should be adopted. The engines can be made lighter, cheaper, and simpler. The subdivision of watertight compartments can be more effectively secured. The propeller need not extend so far beyond the lines of the hull, and therefore would be less liable to disablement from ramming as well as from floating obstructions. Shorter length of shafting could be used as well as smaller engine parts. Triple screws permit the installation of additional auxiliaries, and, as the auxiliaries are the weak links in a modern high-powered ship, the installation of additional ones might be of great advantage. It is but fair to say that there are structural disadvantages due to the additional number of parts required, as well as to the intricacy of piping; but the structural advantages far exceed the disadvantages.

In addition to the economical and structural reasons for installing triple screws, there are tactical advantages to be secured. When the German Admiralty began giving consideration to this subject, her experts did not look for other than economical and structural advantages. It was believed that investigation would show that tactical reasons would prevent the further use of triple screws in German warships. With the fairness and thoroughness that characterize German research, extended experiments were planned for the determination of this question. Vessels of exactly the same hull design were pitted against each other. It was found that the ships fitted with triple screws steered best, and that the art of steering was more easily acquired by the sailors, as, unlike vessels carrying single or double screws, the ships took no rank sheer.

During the past winter the value of triple-screw ships was shown by the wonderful ease and accuracy with which the battleship "Kaiser Wilhelm II." was steered through the Kaiser Wilhelm Canal. The performance of the battleship astonished the naval chief of the Emperor's staff. In going through the narrow curved channel it was necessary for the battleship to go at slow speed, and yet it was essential that the rudder should respond very promptly to the touch of the helmsman. Both of these results were obtained by going ahead at a speed of five knots with the middle screw, and backing equally with both side screws at a three-knot pace. A net speed of but two knots was secured. Since the middle screw was moving at a five-knot speed, the water was thrown against the rudder with sufficient velocity to make the work easy for the helmsman.

The distribution of power by triple screws in very large-powered ships is simply keeping pace with progressive naval construction. The patrons of the ocean greyhounds can be depended upon to give preference to vessels fitted with machinery of this type, for in doing so they would soon bring about an installation of motive power that would increase the safety and reliability of the large-powered ships.

It is a matter of experience that the best-paying railroads are those which keep even in advance of the demands of their patrons. And so would it be in the case of ocean steamships, if life-saving devices were employed before the law compelled their adoption. Every installation or change, which had for its primary purpose the increased protection of the passenger, would command the approval of the travelling public. The ocean liner which would make triple-screw installation its cardinal feature, would reduce to a minimum the chances of its ever becoming helpless. Once let it be known how safe and reliable is such an installation, and the best-paying ocean passengers would not be content to travel on any other type of steamer.

GEO. W. MELVILLE.